

peratures, thermals can limit insecticide deposition of aerial applications unless there are winds of 4 to 10 miles per hour (ideally, perpendicular to the swaths).

- 5 Using canola oil, rather than crop oil, as a carrier may significantly improve the effectiveness of RAATs applications. Canola oil is an effective attractant and feeding stimulant for many rangeland grasshopper species.
- 6 Small-scale trials under optimal conditions indicate that 80 to 85 percent mortality also can be achieved using 100-foot swaths with the following rates and coverages: 5 fluid ounces per acre with 33-foot untreated swaths, 6 ounces with 50-foot untreated swaths, and 7 ounces with 100-foot untreated swaths.

## The future of RAATs

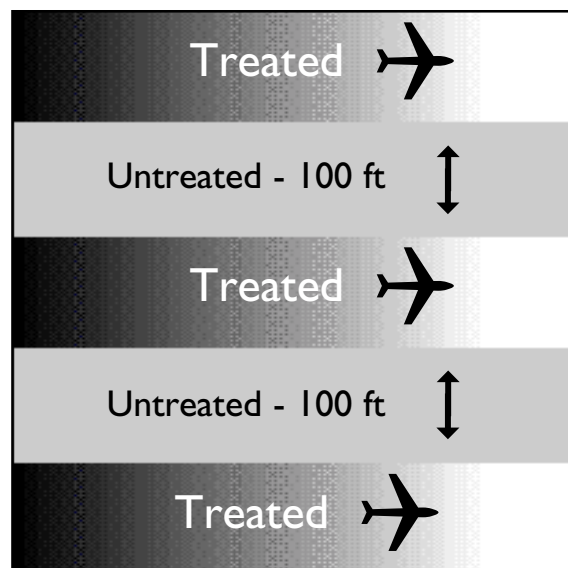
### 2001 Research and Development:

- ❖ Enhancing the efficacy of RAATs using vegetable oils as carriers of carbaryl and diflubenzuron (several oils are attractants and feeding stimulants for rangeland grasshopper species)
- ❖ Refining the parameters of a Dimilin-RAAT program, including minimizing total volume, optimizing the oil:water ratio, and identifying the best oil to use as a carrier
- ❖ Accelerating the optimization of RAATs programs through ecological modeling of the complex biological and physical factors that determine efficacy

For more information and updates, visit our Web Site at [www.sdvc.uwyo.edu/grasshopper/](http://www.sdvc.uwyo.edu/grasshopper/) or contact

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## A schematic of a RAAT application with 50 percent coverage



### Exceptions to the “Rules”

Higher rates or coverages may be needed if: 1) treatments are applied to late instar nymphs (if using diflubenzuron), 2) ground temperatures exceed air temperatures (especially if using malathion), 3) grasshopper densities are extreme, 4) forage cover is tall or dense, or 5) terrain is rough. In all cases, grasshopper management software (CARMA<sup>1</sup> or HOPPER<sup>2</sup>) should be used to assess a program. Apply insecticides in accordance with label directions and established guidelines for buffers around water, bees, and human habitations.

<sup>1</sup> Available at [www.sdvc.uwyo.edu/grasshopper/carma.htm](http://www.sdvc.uwyo.edu/grasshopper/carma.htm)

<sup>2</sup> Available from your USDA APHIS State Plant Health Director

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# Do more with less, using **Reduced Agent and Area Treatments (RAATs)**



**Refining**  
*the newest strategy  
for rangeland  
grasshopper management —  
an economical and  
environmental win-win  
approach to pest management*

## What is RAATs?

RAATs is a method of integrated pest management (IPM) for rangeland grasshoppers, in which the rate of insecticide is reduced from traditional levels, and untreated swaths (refuges) are alternated with treated swaths.

RAATs works through *chemical control*, meaning grasshoppers are killed in treated swaths as they move out of untreated swaths, and *conservation biological control*, which allows predators and parasites preserved in untreated swaths to suppress grasshoppers. This IPM approach can reduce the cost of control and the amount of insecticide used by more than 50 percent.

## Why use RAATs?

### Economics

Inflation and the end of the USDA cost-share program has tripled the cost of rangeland grasshopper management for ranchers compared with the control cost during the last major outbreak in 1987. Most states no longer subsidize grasshopper control programs. Therefore, the cost of traditional tactics usually will exceed the benefits.

### Environment

Less insecticide in the environment lowers the risk to native species (including fish and wildlife), water quality, and humans. The untreated swaths provide a refuge for organisms with lower mobility than grasshoppers, and even those organisms that move into the treated swaths will be largely unaffected unless they feed on the foliage.

## What to expect from RAATs

### Efficacy

This method normally will result in 80 to 95 percent control, which is approximately 5 to 15 percent lower mortality than with a standard (high rate,

blanket coverage) treatment. Leaving low densities of grasshoppers after RAATs does not necessarily result in a subsequent outbreak (see *Environment*).

### Economics

Using RAATs will reduce costs by approximately 50 to 60 percent, depending upon the agent and swath width. For example, if a standard insecticide application costs \$2.50 per acre, the equivalent RAATs program should cost approximately \$1.15 per acre. In some cases, costs are reduced by two-thirds. It should be noted that the greatest economical benefits derive from swath spacing since it effectively decreases the costs for both purchasing insecticides and application.

### Environment

RAATs means 60 to 75 percent less insecticide is applied to our rangelands for grasshopper control. The untreated swaths harbor species essential to rangeland ecosystems, including biocontrol agents of grasshoppers and weeds. Low densities of surviving grasshoppers allow predators and parasites in the untreated refuges to recolonize and thereby reestablish natural regulation of grasshopper populations. For these reasons, RAAT programs also may sustain higher densities of birds than blanket applications.

## How to use RAATs

Research conducted by University of Wyoming and USDA scientists in cooperation with state departments of agriculture and weed and pest districts has involved 179 40-acre experimental plots and 15 640-acre operational trials at densities of 7 to 70 grasshoppers per square yard from 1995 to 2000. The following tactics most often optimize economic returns and are recommended by the National Grasshopper Management Board:

1. Apply carbaryl (*Sevin XLR<sup>1</sup>*) at a rate of 8 fluid ounces per acre (=113 grams of active ingredient) with an equal volume<sup>2</sup> of water at pH 7 in 100-foot swaths<sup>3</sup>, alternating with 100-foot untreated swaths (compared with the traditional approach of using 16 fluid ounces per acre in a blanket coverage).
  2. Apply<sup>4</sup> diflubenzuron (*Dimilin 2L*) at a rate of 0.75 fluid ounces per acre (=5.3 grams of active ingredient) with 8 fluid ounces of water and 4 fluid ounces of oil, in 100-foot swaths<sup>3</sup> alternating with 100-foot untreated swaths **OR** apply at a rate of 1 ounce per acre with 16 ounces of water and 8 ounces of canola oil<sup>5</sup>, in 100-foot swaths<sup>3</sup> alternating with 200-foot untreated swaths (compared with the standard approach of using 1 fluid ounce per acre in blanket coverage).
  3. Apply malathion (*Fyfanon*) at a rate of 4 fluid ounces per acre (=138 grams of active ingredient) in 100-foot swaths<sup>3</sup>, alternating with 25-foot untreated swaths<sup>6</sup>, (compared with the traditional approach of using 8 fluid ounces per acre in a blanket coverage).
- 1 This RAATs method has been adopted in a 2EE label for most western states.
- 2 Increasing the volume of water above the 1:1 ratio with carbaryl will not improve, and may reduce, efficacy.
- 3 Facilitating droplet dispersal by using Micronaire nozzles or turning conventional nozzles angled 45 degrees into the wind may enhance efficacy. In addition, wider treated swaths (>100 foot) may be used. While it may be possible to proportionately expand untreated buffers, this approach has not been tested. Thus, the most prudent tactic at this time would be to maintain the fixed widths of the untreated swaths.
- 4 Experimental applications have demonstrated that RAATs provides more than 90 percent mortality when ground temperatures exceed air temperatures by as much as 15 degrees Fahrenheit. Extensive research in Australia has demonstrated that when ground temperatures exceed air tem-